Computational Fluid Dynamics in the Indoor Environment, New Developments and Quality Considerations

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ABSTRACT

The indoor environment community has adopted Computational Fluid Dynamics (CFD) as a useful tool for the prediction of air movement in ventilated spaces. The method has been used for many years as a research tool, and now it is used routinely in civil engineering when a large or complicated ventilation system is to be designed. The paper describes new developments important for the use of CFD in the indoor environment, and it discusses quality considerations that are also important because of the large number of new CFD users.

The paper discusses the quality level of first, second and third order schemes by use of the "Smith and Hutton problem" on the mass fraction transport equation. It is shown that schemes with second and third order of accuracy represent an important improvement and they should be used whenever it is possible.

Aspects of the simulation of Air Terminal Devices are discussed in the next chapter, and examples are given of practical specifications of boundary conditions of such diffusers.

Important considerations obtained by comparison of results from predictions made by the $k-\varepsilon$ turbulence model and the Reynolds Stress turbulence Model are addressed in the last chapter of the paper. It is shown that the three-dimensional wall jet behaviour in a deep room can be predicted with a higher accuracy by the use of suited wall reflection terms in a Reynolds Stress Model compared to predictions made by a $k-\varepsilon$ model.